IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicants : Hamid Hojaji et al.

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DECLARATION UNDER 37 C.F.R. § 1.132

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, PEDRO M. BUARQUE DE MACEDO, declare that:

1. I am the co-inventor and assignee of the above-referenced U.S. Patent Application Serial No. 10/625,071 filed on July 22, 2003 in the name of Hamid Hojaji and Pedro M. Buarque de Macedo and entitled "STRONG, HIGH DENSITY FOAM GLASS TILE HAVING A SMALL PORE SIZE."

2. I am familiar with the above-referenced patent application and the prosecution thereof before the U.S. Patent Office. I am also familiar with the Office Action dated November 24, 2006 issued therein. For the purposes of preparing this Declaration, I have reviewed the prior art references cited in the Office Action, including U.S. Patent No. 5,588,977 to Pavlov et al. ("the Pavlov '977 Patent"), U.S. Patent No.

5,821,184 to Haines et al. ("the Haines '184 Patent") and U.S. Patent No. 5,069,960 to Fukumoto et al. ("the Fukumoto '960 Patent"). Based on my extensive academic and research experience as described below I am generally familiar with the field related to the above-mentioned prior art references and I believe that I am qualified as an expert in that field.

3. I received a Bachelor of Science degree in Physics from George Washington University in Washington D.C. in 1959, and received a Ph.D. in physics from The Catholic University in 1963. From 1963 to 1967, I was employed with the National Bureau of Standards, and afterwards I continue to be associated with the National Bureau of Standards as a consultant. In 1967, I joined the department of mechanics at The Catholic University of America as an associate professor. In 1970, I became a co-director of the Vitreous State Laboratory and also a professor of chemical engineering and material science at the same university. Currently, I continue to be the director of the Vitreous State Laboratory and am a professor of physics at the same university. The article in the Summer 2002 issue of the *CUA Magazine*, "Defending Against Environmental Disaster: CUA's Vitreous State Lab Has Answered the Nation's Call for 30 Years" by Richard Wilkinson, a copy of which is attached hereto as Exhibit 1, describes my contributions and achievements as a co-director of the Vitreous State Laboratory.

4. My primary area of expertise is in glass science research. In particular, I have developed technologies and products in the areas of fiber optics, defense fuels, and radioactive waste glass formulation. I have received over 40 patents in the United States and many more worldwide, and have been noted as "the area's leading individual

inventor in number of patents granted" by the January/February 1990 issue of *Washington Business Journal Magazine*. For more details of my background and areas of expertise, please refer to my curriculum vita attached hereto as Exhibit 2.

5. I have reviewed the Pavlov '977 Patent, and do not find therein any teaching or even suggestion of a foam glass tile having, *inter alia*, a compression strength of 10,000 psi or greater, as required by Claim 90, let alone the claimed range of 12,500 psi or greater for Claim 63. At best, the Pavlov '997 Patent discloses in Example 22 a foam glass product having a compression strength of 8,700 psi (converted from 60MPa), which falls short of the claimed range of 10,000 psi or greater for Claim 63, let alone the claimed range of 12,500 psi or greater required by Claim 90. *See* Pavlov '997 Patent, Example 22, Col. 11, lines 45-55. All other examples of the Pavlov '997 Patent disclose foam glass products having a compression strength less than 8,700 psi.

6. Furthermore, the Pavlov '977 Patent discloses that the pore sizes of its foam glass material can range to "several millimeters." Pavlov '977 Patent, Col. 6, lines 13-14. As further explained in Paragraph 7 below, in the course of making strong foam glass tiles as disclosed and claimed in the present application, we have found that the size of the largest pore or bubble within a foam glass material can be one of the necessary factors in determining its compression strength. In general, we found the presence of large bubbles weaken the foam glass material and indicate a low compression strength.

7. To make a strong foam glass tile as described in the present application, we made many examples of various compression strength, and from these examples, we

have found the following necessary properties of the strong foam glass tiles that are made in accordance with the present invention: (a) The higher the density of the finished foam glass tile, the stronger the foam glass tile. This property would be counter-intuitive to the conventional wisdom for desiring light foam glass tiles since a higher density means a heavier weight; and (b) foam glass tiles having small pore sizes are generally stronger than foam glass tiles having larger pore sizes. More specifically, the pore size is determined by the largest dimension of the pore, and the compression strength of a foam glass tiles was seen impacted by the largest pores. However, these are necessary but not sufficient conditions for the strong foam glass tiles. In fact, our recent efforts to replicate the foam glass article in accordance with the teachings of the Haines '184 Patent, as discussed in Paragraph 12 below, show that not all foam glass tiles having the average pore size and density within the claimed ranges required by the pending claims can achieve the claimed compression strength. Thus, while the claimed ranges of average pore size and density are necessary properties of a strong foam glass tile in accordance with the present invention, they are not sufficient by themselves to lead to the claimed compression strength. The procedures disclosed in the present application teach a method by which a foam glass tile with the appropriate pore size and density and compression strength, as claimed, can be made.

8. By way of comparison, the color photographs in FIGS. 1-3 below this paragraph show the cross sectional views of the foam glass tile samples made in accordance with the present invention. In fact, FIGS. 1-3 correspond respectively to Examples 7-9 in TABLE 3 of the present application. Once the corresponding samples

were made, they were cut to take the measurements of various properties, revealing the cross sectional views shown in FIGS. 1-3. FIG. 1 corresponds to a foam glass tile of Example 7 having an average pore size of 0.8 mm. As can be seen from FIG. 1, none of the largest pore sizes is over 1.0 mm. The measured compression strength of Example 7 is 10,500 psi. Similarly, Example 8 shown in FIG. 2 has an average pore size of 0.6 mm, with, again, none of the largest pore sizes over 1.0 mm. It achieves a compression strength of 12,500 psi. Example 9 shown in FIG. 3 has an average pore size of 0.3 mm, with none of the largest pore sizes over 1.0 mm, and achieves a compression strength of 14,600 psi.

FIG. 1: Example 7 of Present Invention in TABLE 3

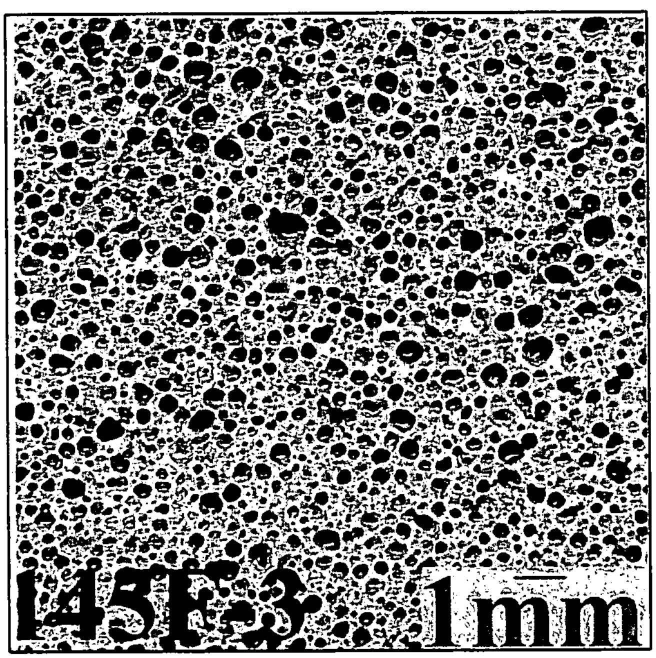


FIG. 2: Example 8 of Present Invention in TABLE 3

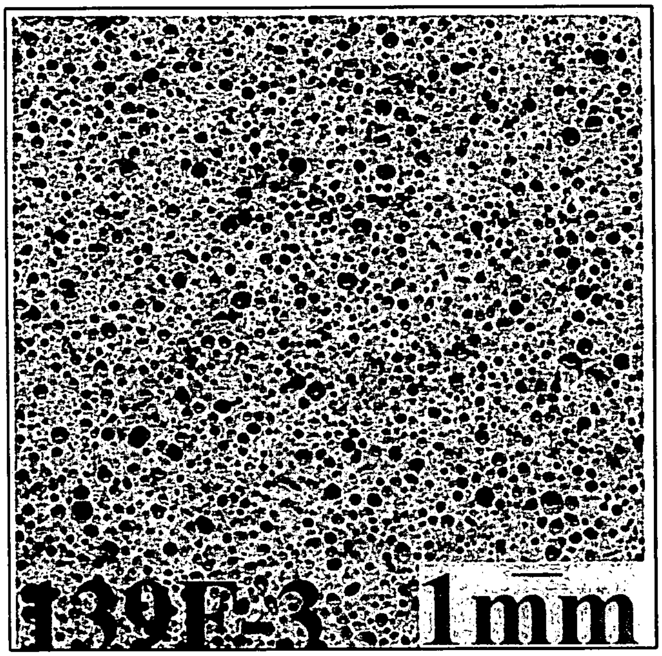
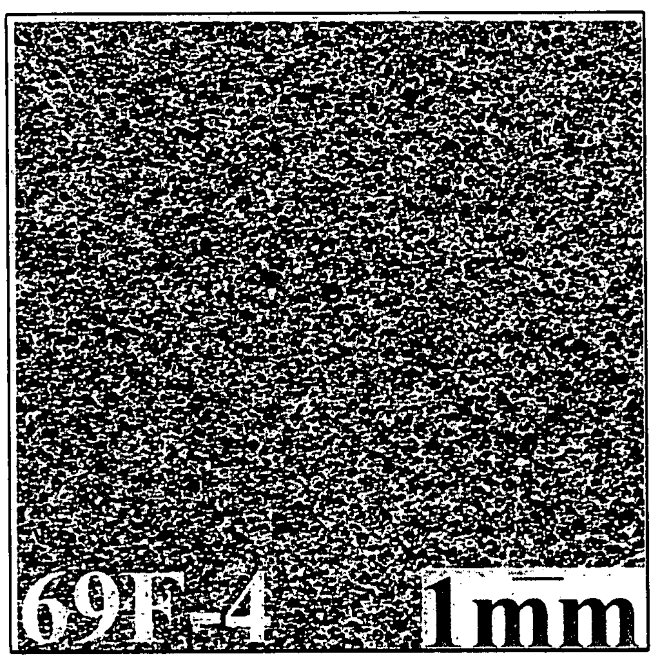


FIG. 3: Example 9 of Present Invention in TABLE 3



9. Based on my foregoing observations that small pore sizes with the largest of them being smaller than 1.0 mm are necessary (but not sufficient by themselves) condition for a high compression strength in a foam glass tile, as well as my general knowledge that the presence of large pores or bubbles tend to weaken a foam glass material, I conclude that a foam glass material having largest pores reaching several millimeters in size would unlikely achieve the claimed range of 10,000 psi or greater in compression strength as required by Claim 90, let alone the claimed range of 12,500 psi or greater required by Claim 63. This further confirms my earlier observation that the Pavlov '977 Patent does not disclose the claimed ranges of compression strength.

10. I have also reviewed the Haines '184 Patent, and do not find any teaching or suggestions therein of a foam glass tile having, *inter alia*, a compression strength within the claimed range of 10,000 psi or greater as required by Claim 90, let alone the claimed range of 12,500 psi or greater for Claim 63. In fact, I do not find any compression strength data for the 18 examples of foam glass articles in the Haines '184 Patent.

11. Of the 18 examples of foam glass articles disclosed by the Haines '184 Patent, none has a density within the claimed range of 50 pcf or greater as required by independent Claim 90. Furthermore, of the 18 examples, Example 17 is the only example having a density (42.6 pcf) and an average pore size (ranging between 0.01 and 0.10 mm) that are both within the claimed ranges required by independent Claim 63. *See* Haines '184 Patent, Example 17, Col. 9, line 62. However, the Haines '184 Patent provides no compression strength data for any of the examples, including Example 17.

The properties of the 18 examples of the Haines '184 Patent are summarized in a table below:

REFERENCE: HAINES USP# 5,821,184 '184									
EXAMPLE	DENSITY (pcf)	IN/OUT	PORE SIZE (mm)	IN/OUT	TILE SIZE (in)	VOLUME (in)	VOLUME (ft)	MASS (lbs)	IN/OUT (10# -IN)
1	13.9	OUT	0.5 - 2.0	OUT	4x4x4	64	0.0370	0.5148	OUT
2	7.2	OUT	1.0 - 3.0	OUT	NO SIZE GIVEN				?
3	17.6	OUT	0.05 - 0.2	IN	2x3x4	24	0.0139	0.2444	OUT
4	15.3	OUT	0.01 - 0.1	IN	NO SIZE GIVEN				?
5	24.3	OUT	0.1 - 0.5	IN	3x2x8	48	0.0278	0.6750	OUT
6	19.8	OUT	0.05 - 0.2	IN	NO SIZE GIVEN				OUT
7	11.2	OUT	0.5 - 1.5	OUT	4x3.75x2	30	0.0174	0.1944	OUT
8	15.6	OUT	0.5 - 1.0	IN	NO SIZE GIVEN				?
9	27.8	OUT	1.0 - 3.0	OUT	NO SIZE GIVEN				?
10	17.2	OUT	2.0 - 4.0	OUT	NO SIZE GIVEN				?
11	19.5	OUT	1.0 - 2.4	OUT	6d, 2t	56.52	0.0327	0.6378	OUT
12	14.8	OUT	0.5 - 1.5	OUT	5d, 2t	39.25	0.0227	0.3362	OUT
13	11.9	OUT	1.2 - 2.8	OUT	2x3.75x7.25	54.375	0.0315	0.3745	OUT
14	18.3	OUT	2.0 - 4.0	OUT	NO SIZE GIVEN				?
15	16.6	OUT	0.05 - 0.2	IN	4x4x8	128	0.0741	1.2296	OUT
16	28.6	OUT	0.01 - 0.2	IN	4x4x3	48	0.0278	0.7944	OUT
17	**42.6**	**IN**	**0.01 - 0.1**	**IN**	**NO SIZE GIVEN**				**?**
18	19.3	OUT	0.2 - 0.5	OUT	1x2x20	40	0.0231	0.4468	OUT

12. Under my direction and supervision, an experiment was conducted in my university laboratory to replicate the foam glass article described in Example 17 of the Haines '184 Patent. *See* Haines '184 Patent, Col. 9, lines 57-63. Example 17 indicates that a procedure similar to that of Example 1 is used. All of the steps and recipes for producing a foam glass block as prescribed by Examples 1 and 17 of the Haines '184 Patent were faithfully followed in the experiment to every extent possible. These steps and recipes are summarized in the table below:

	EXAMPLE 1			EXAMPLE 17			
CHEMICAL	WT (g)	%	MESH	WT (g)	%	MESH	
CALCIUM CARBONATE, $CaCO_3$	13.68	2.4	>200	114	20	>325	
RECYCLED **PLATE GLASS**	442.32	77.6	>140	456	80	>325	RECYCLED **CONTAINER GLASS**
SAND	114	20	60_100				
TOTAL	570	100		570	100		

PROCESS STEPS TO REPLICATE EXAMPLE 17 (AS ABOVE)
1 Mix powders thoroughly
2 Place resulting mixture in a stainless steel mold, approx. 4.25"x4"x8.25"
3 Cover mold with a 0.5" stainless steel plate
4 Fire the mold with the mixture therein at 1250 °F (677°C) to sinter for 60 minutes
5 Foam for 15 minutes at 1700 °F (927°C)
6 Anneal by cooling slowly to room temperature for 120 minutes
7 Remove the cooled block of foam glass from the mold
8 Remove the outer layer of crust with a saw
9 Measure the density, pore size distribution and compressional strength of the finished product.
10 Check if cells are interconnected

13. I found that the foam glass article produced in the above experiment matches the density and pore size distribution disclosed in Example 17 of the Haines '184 Patent, confirming that the experiment properly followed the teachings set forth in the Haines '184 Patent. A series of color photographs below this paragraph, FIGS. 4-8, show the foam glass article produced in accordance with the teachings set forth in Example 17 of the Haines '184 Patent in the above experiment that were taken from various angles.

FIG. 4: Replication of Example 17 of Haines '184 Patent Seen From the Top

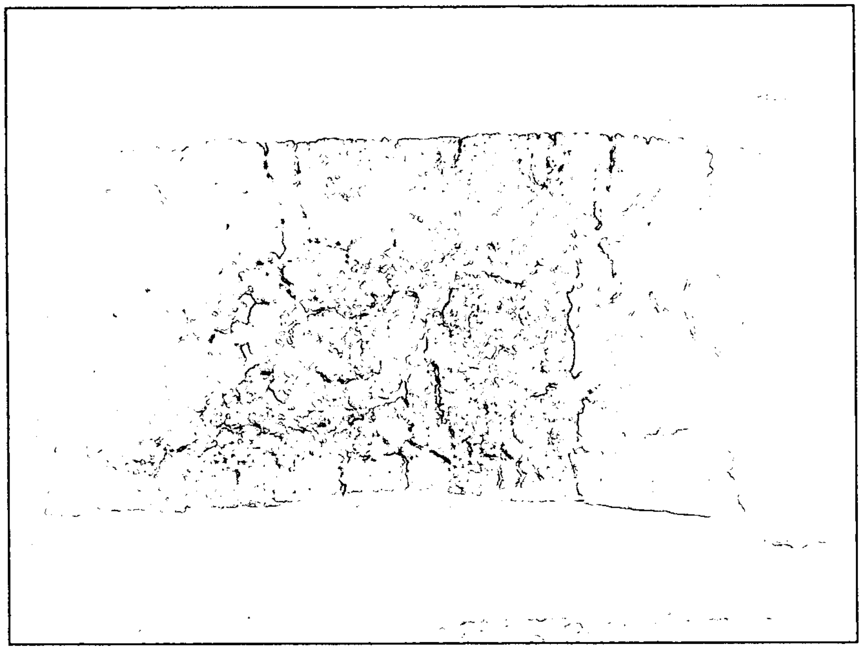


FIG. 5: Replication of Example 17 of Haines '184 Patent Seen From A Side

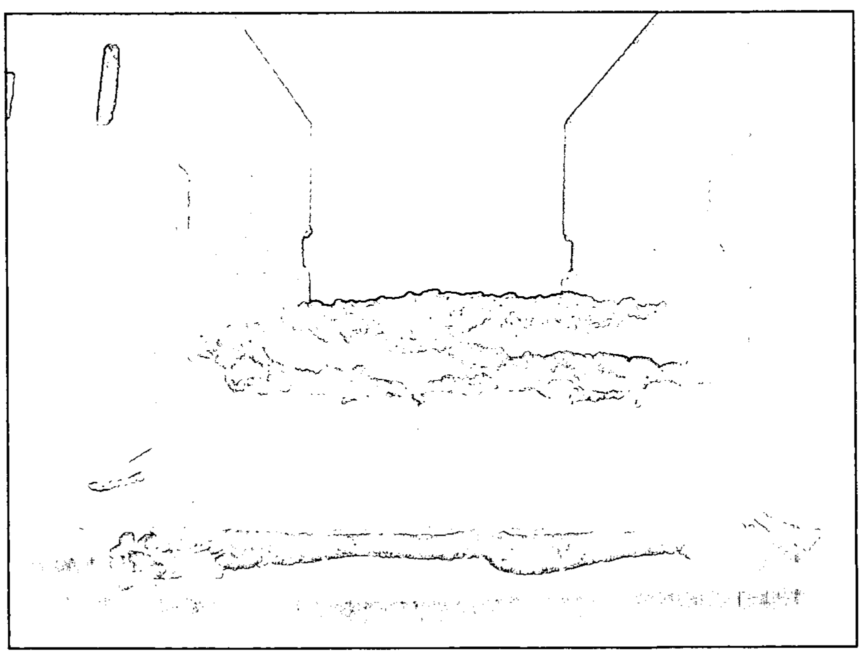


FIG. 6: Replication of Example 17 of Haines '184 Patent Seen From Another View

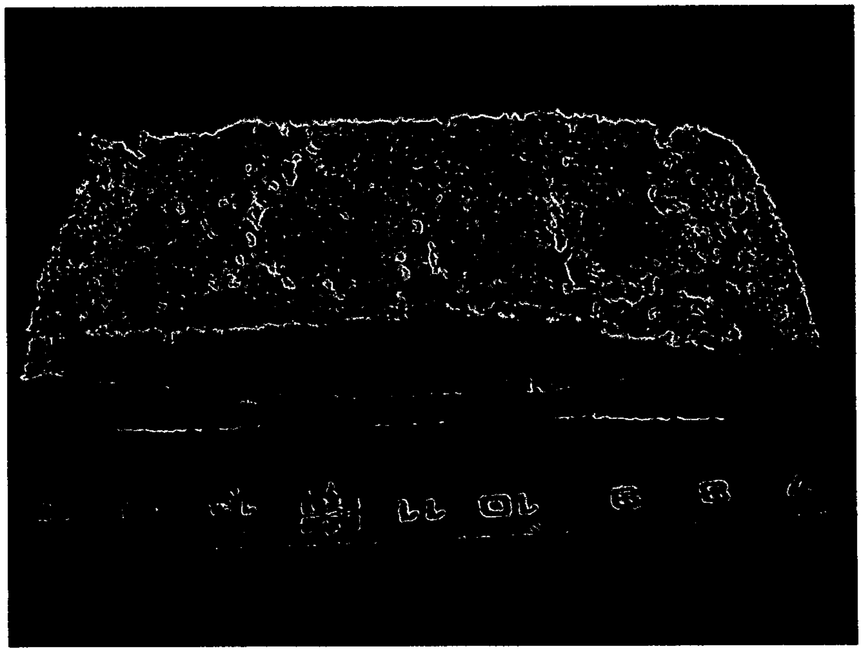


FIG. 7: Replication of Example 17 of Haines '184 Patent Seen From Another View

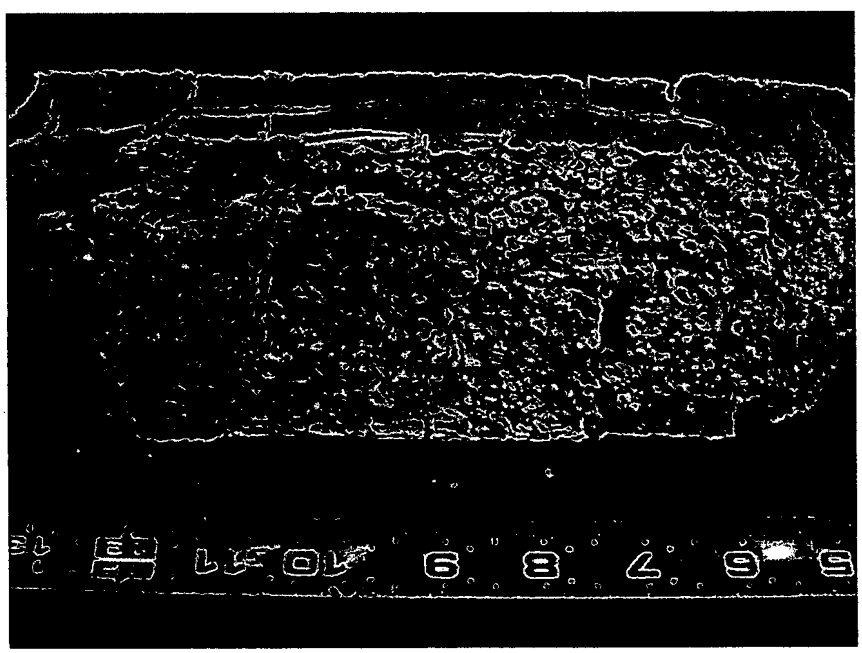


FIG. 8: Replication of Example 17 of Haines '184 Patent Seen Closely at the Pore Size Level (Marks on the Bottom Indicating a Millimeter)

14. The above figures, FIGS. 4-8, clearly show that the foam glass article produced in accordance with Example 17 of the Haines '184 Patent developed large cracks and severe fractures running across the surfaces and through the body.

15. I also observed that while the pores or bubbles in the foam glass article produced in accordance with Example 17 of the Haines '184 Patent have the sizes disclosed by the Haines '184 Patent, i.e., ranging from about 0.01 to 0.1 mm, they are in fact mostly interconnected, with the resulting interconnected bubble structure reaching several millimeters in length. This can be seen from a close-up view of the fluffy sample shown in FIG. 8, although the photo does not have a very clear contrast against the white sample. My observation is confirmed by the Haines '184 Patent which discloses

that "the cell structure of the inventive foam glass is open, interconnected, and irregular." Haines '184 Patent, Col. 4, lines 61-62.

16. Based on the foregoing observations, I conclude that the foam glass article produced in accordance with Example 17 of the Haines '184 Patent containing large cracks and fractures, as well as long interconnected bubbles, running across the surface and through the body do not meet the necessary condition to achieve a high enough compression strength suitable for the intended purpose and use contemplated by the present invention, which include use for protective building surfaces and shock absorption.

17. I was not able to obtain any compression strength measurement from the foam glass article produced in accordance with Example 17 of the Haines '184 Patent, since it was too badly cracked. However, even without taking any measurement, based on its clearly observable fragile condition as shown in FIGS. 4-8, I conclude that it does not meet the necessary condition to possess a high compression strength even at the level of 4,000 psi, which is a typical compression strength of a concrete, let alone the claimed ranges of 10,000 psi and greater as required by Claim 90, or 12,500 psi and greater as required by Claim 63.

18. By way of comparison, the photographs of the cross sectional views of foam glass tile samples that are made in accordance with the present invention as shown in FIGS. 1-3 above, having the respective average pore sizes, densities and compression strengths (as described respectively for Examples 7-9 in TABLE 3 of the present application) within the claimed ranges set forth in the pending claims show no cracks or

interconnected pores. The difference between the claimed invention and the foam glass article produced in accordance with the teachings of the Haines '184 Patent could not be more apparent.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: March 26, ~~2006~~ 2007
PBM
PMBM

By: Pedro M Buarque de Macedo
Pedro M. Buarque de Macedo, Ph.D.